The Effect of Stream Current Velocity on the Habitat Preference of a Net-Spinning Caddis Fly Larva, *Hydropsyche oslari* Banks

(Trichoptera: Hydropsychidae)

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Measuring stream current velocities at the microhabitat of fresh water invertebrates has been a major sampling problem in quantitative research on lotic environments. Ambuhl (1959) and others have studied current velocity in clear water by a variety of techniques including the use of dyes, salt tablets and acetyl cellulose particles. The objectives of this study are to 1) ascertain what effect, if any, stream current velocity had on the distribution at the microhabitat level of the larvae of *Hydropsyche oslari* Banks, a stationary, net-spinning caddisfly and 2) to determine if current measurements made at the surface were comparable to those taken in the microhabitat of the insect.

The larvae of *Hydropsyche,* in contrast to most other genera of caddisflies, construct non-portable cases using pebbles, small wood fragments and occasionally parts of leaves (Fig. 1). The case is usually attached to a submerged rock or branch. A sieve net is spun at the anterior, upstream side of the case and the larva feeds on the particulate matter that collects. Adequate current flow is thus important for two purposes: it provides a vehicle for the transport of food to the stationary larva and is also important in providing a constant supply of oxygen. Larvae removed from their natural habitats and placed in aquaria having the same water temperature will initiate abdominal undulating movements to increase the flow of water over the gills.

Philipson (1954), working with *Hydropsyche instabilis* in England, demonstrated under laboratory conditions that larvae subjected to a current velocity of 30 cm/sec built silken feeding nets incorporating stones and pebbles. In still water, larvae constructed crude silken networks and in no cases were a typical net observed. Scott (1958) correlated numbers of *Hydropsyche instabilis* larvae with surface current velocity and found the mode at 40–50 cm/sec in a stream in the British Isles. Edington (1968) studying *Hydropsyche instabilis* and *Plectrocnemia conspersa* in England found that the former species preferred a velocity range of 15–100 cm/sec whereas the latter was characteristic of a velocity range of 0–20 cm/sec.

The habit of net-spinning by hydropsychid larvae has created an economic problem for hydroelectric plants in Japan. Hiro (1956) reported that approximately 80% of the power plants in Japan were

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Fig. 1. Larval retreats of *Hydropsyche oslari* Banks. X5. Fig. 2. Rearing troughs — designed to maximize suitable current conditions.

suffering from loss of power which amounts from 3 to 20% of the power obtainable, due to the habit of the larvae building retreats on the walls of water tunnels and reducing the rate of water flow.

Tsuda (1962) has discussed the use of a variety of control techniques to alleviate water tunnel clogging by *Hydropsyche* and other genera including frequent cleaning of larval nets from tunnel walls, use of natural enemies, electric shock, poisonous paints and insecticides, smoothing out the tunnel surfaces to prevent purchase and colonization by larvae and the light-trapping of adults.

Materials and Methods

Tonto Creek, Gila Co., Arizona, approximately 100 miles northeast of Phoenix at an elevation of 1585 meters was selected as the study site. Current velocity measurements were made with a battery powered pygmy current meter. The small size of the instrument made

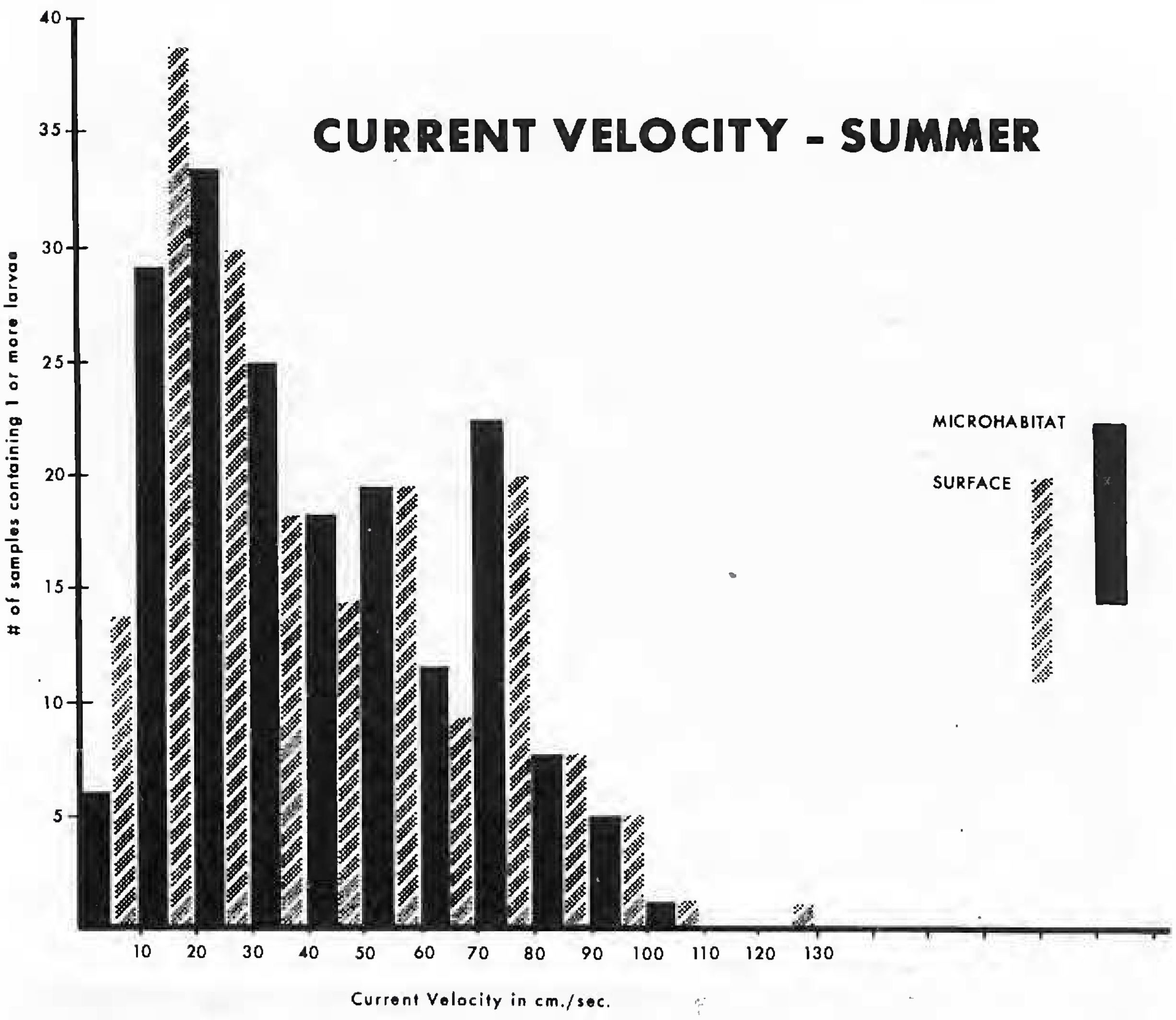

Fig. 3. Distribution of *Hydropsyche oslari* larvae with respect to surface and microhabitat current velocities during the summer.

it possible to obtain measurements adjacent to the larval retreats. Sampling proceeded across and upstream so that any larvae that might be dislodged would not affect data obtained later. Spring measurements were taken from March to early May. As larvae are replaced by pupae and adults in May and June, no sampling was done at this time. Summer data collecting commenced in mid July, when early instar larvae of the next generation were first noted to be present, and was completed by the end of August. During each period 176 measurements were made.

Larval and adult associations for purpose of species identification were made by laboratory rearing. Larvae were placed in .30 x 2.1 m wooden troughs in which baffles were fitted to increase water turbulence (Fig. 2). Rocks were placed in the trough to simulate stream conditions, with hypolimnionic water pumped in from a nearby lake. Canned baby food spinach was used as food to supplement algae. Pupae were placed in small individual wire cages and the trapped adults that emerged were pinned or placed in alcohol.

Results and Discussion

Larvae of *Hydropsyche oslari* exhibit habitat selection with respect to current velocity at the level of the microhabitat. The selectivity is less pronounced during the summer (Fig. 3) probably due to the ovipositing female than it is during the spring period (Fig. 4).

Current velocity measurements taken during the summer at the stream surface ($\bar{x}$ = 40 ± 27 cm/sec) and the microhabitats ($\bar{x}$ = 42 ± 25 cm/sec) of the larvae are not significantly different (Fig. 3). Early instar larvae at the microhabitat level prefer a moderately rapid current velocity at this time of year. The range of habitat selectivity with respect to current is broad (5-101) as was demonstrated by Edington (1968) for a British species and is probably due initially to the wide selectivity by the ovipositing female. It is likely that the female is oriented to other factors in the environment such as overhanging vegetation and diminished sunlight in addition to surface current velocity. Larvae were not found in significant numbers in water flowing slower than 10 cm/sec or faster than 100 cm/sec.

Surface and microhabitat measurements were significantly different during the spring sampling period (Fig. 4). The current velocity affecting the larval nets ranged from 4 to 138 cm/sec ($\bar{x}$ = 50 ± 22) while that at the surface was 10 to 285 cm/sec ($\bar{x}$ = 76 ± 42). During periods of maximum runoff in the spring, surface data thus gives no indication of conditions actually affecting the juvenile stages. The minimal and maximal values affect the larvae from the standpoint of oxygen and food availability. Larval nets must have enough current to bellow them out but not enough to wash them away.

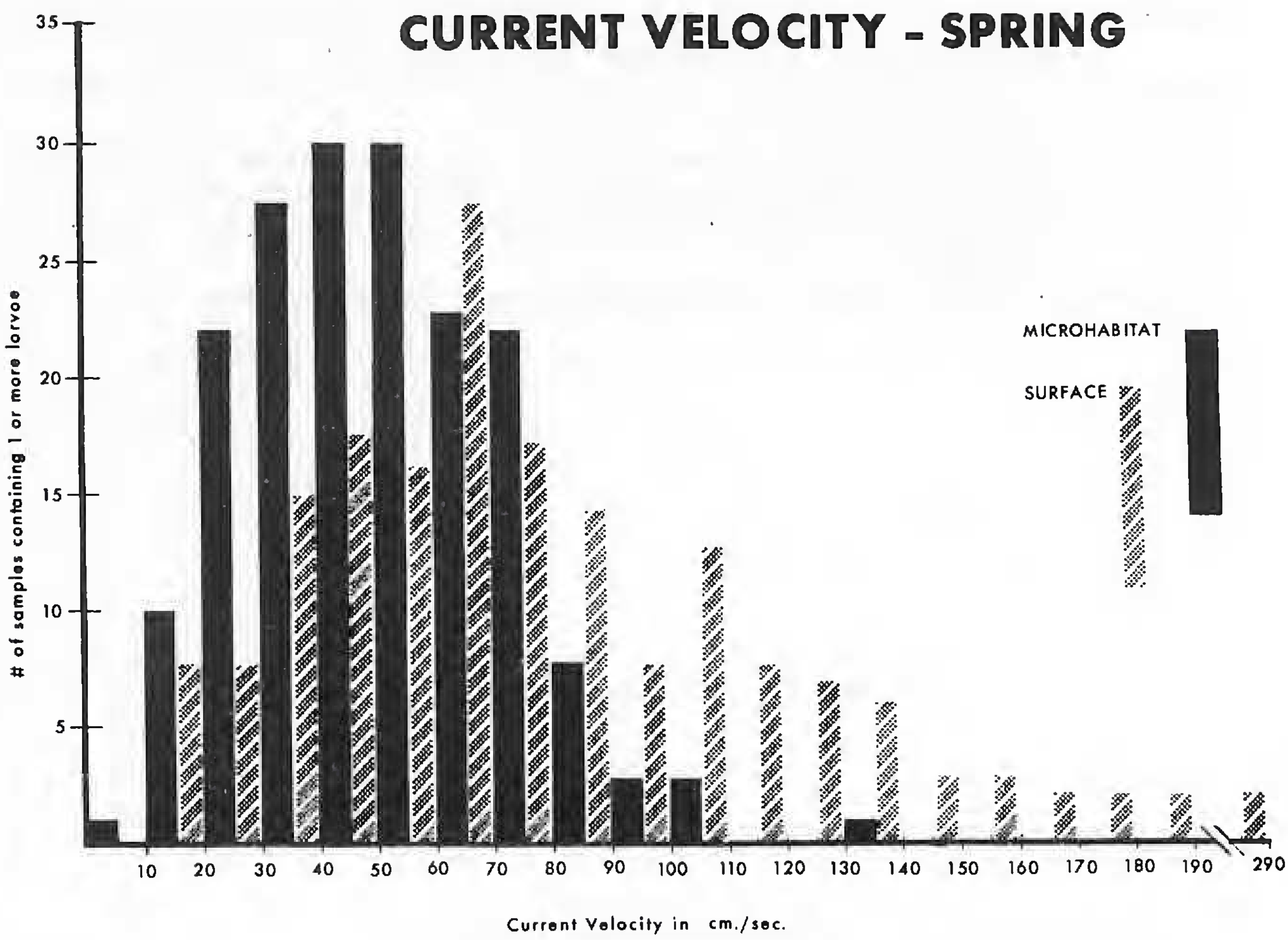

Fig. 4. Distribution of *Hydropsyche oslari* larvae with respect to surface and microhabitat current velocities during the spring.

Data obtained from the microhabitat during the summer and spring periods indicates that there is no significant difference between the two although surface measurements varied greatly. Larvae are either moving out of areas with extremely high velocity and into more favorable situations during the early spring or are being swept downstream.

Acknowledgements

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